UNIVERSITY OF NATAL

PIETERMARITZBURG

SOUTH AFRICA

WATTLE RESEARCH INSTITUTE

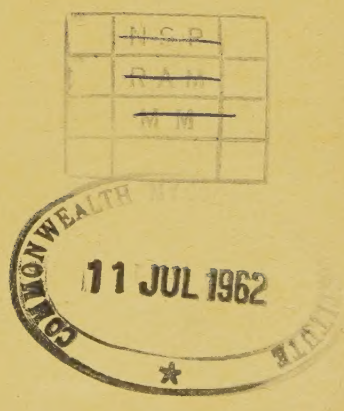
South African Wattle Growers' Union — University of Natal —

Government Department of Forestry

REPORT FOR 1961–1962

(FIFTEENTH YEAR)

MAY, 1962



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COMMITTEE OF CONTROL OF THE INSTITUTE

Appointed by the South African Wattle Growers' Union (3) :

Major C. J. J. Crowe.

T. F. Mackenzie, Esq. (*Chairman*).

H. F. C. Kusel, Esq.

Appointed by the University of Natal (2) :

Professor A. J. W. Bayer, D.Sc. (*Vice-Chairman*).

Principal E. G. Malherbe, M.A., Ph.D., LL.D.
Alternate: Professor E. R. Orchard, M.B.E., B.Sc., Ph.D., F.R.I.C.

Appointed by the Government Department of Forestry (2) :

M. van N. Möhr, Esq., B.Sc. (*Resigned December*, 1961).

J. H. van Wyk, Esq., M.Sc., M.F.

T. F. F. Garnett, Esq., B.Sc., B.Sc.(For.). (*Appointed January*, 1962).

The Director :

Professor H. Shaw, M.Sc.Tech., Ph.D., F.R.I.C.

Honorary Secretary :

P. G. Leeb-du Toit, Esq., B.Com. (*Registrar, University of Natal*).

STAFF

MAY, 1962

DIRECTOR :

H. Shaw, M.Sc.Tech., Ph.D.(Manc.), F.R.I.C.

Silviculture :

S. P. Sherry, M.A.(Oxon.), B.Sc. (South Africa).
R. J. F. J. Atkins, B.Sc.For. (Stell.).
A. P. G. Schönau, Landb.Ir.(Wageningen). (*Appointed May*, 1962).

Technical Assistants :

M. J. Lourens.
I. S. Alexander.
P. J. D. Nicholson.

Genetics and Plant Breeding :

A. A. Moffett, B.Sc.(Birm.), Ph.D.(Lond.).
Miss K. M. Nixon, M.Sc. (Natal).

Technical Assistants :

A. R. Field. (*Resigned February*, 1962).
P. V. Poggenpoel. (*Appointed March*, 1962).

Plant Physiology :

F. C. J. Zeijlemaker, D.Sc. (Amsterdam).

Technical Assistant :

R. E. Thurston.

Chemistry :

W. S. Martin, Ph.D., D.Sc.(Lond.), A.R.C.S., D.I.C., A.R.I.C.
C. G. Gordon-Gray, M.Sc. (Natal). (*Resigned September*, 1961).

Technical Officer :

R. A. Jones.

Entomology :

Technical Officer :

G. B. Wortmann, B.Sc. (Natal). (*On overseas study leave*).

Biometry :

Administration :

Miss E. K. Smith.
Mrs. E. I. Haysom (part-time). (*Appointed October*, 1961).

Non-Europeans :

Eight.

Field Experiment Station Overseer (S.A.W.G.U.) :

M. A. Stewart.

FOREWORD

The change in the administrative year of the Institute, made necessary by a similar change in the financial year of the South African Wattle Growers' Union, has inevitably affected the form of this present Report, which covers a period of only seven months. The field investigations in progress, constituting much the greater part of the Institute's work, are highly seasonal and for years past have been reported up to the end of the season closing some six months before the appearance of the Report in October. At the time of writing, however, the current season's work is not complete, still less has there been time for analysis and interpretation of the results. In consequence, there is little to add to the last published Report, and future Reports will record seasons ended over a year earlier.

The opportunity thus offered by an otherwise meagre technical report has been taken to publish the recently-revised general programme of the Institute, with a brief indication of the history and current status of each project. It is hoped that this will give a more comprehensive picture than the usual annual reviews in which, in any one year, only a fraction of the work in progress is discussed.

In other respects, too, the Institute is passing through a phase of re-organization and, to some extent, of re-orientation. The experience of the past twelve years or so has raised new problems, reduced the significance of others, and led to changes of emphasis in a number of directions. The corresponding adjustments of staff and re-allocation of posts cannot be carried out instantly, but a start has been made and the changes should be complete within a year or two.

The Wattle Industry as a whole is experiencing a period of heart-searching and revision of ideas, and it is abundantly clear from the experimental results coming forward and being sustained from year to year that the Institute has a major contribution to make to the stream-lining and generally increased efficiency of the growing and harvesting side of the industry.

H. SHAW, *Director.*

May, 1962.

ADMINISTRATIVE REPORT

BUILDINGS AND PLANTATIONS

Main Buildings.

The only events of note in the period under review were the completion of the new glasshouse by the installation of internal spray equipment and the fitting of external hail-guards, and the modification of a principal laboratory to meet the needs of the Plant Physiologist.

Field Experiment Station.

Harvesting of experimental plots continued at a high level and the season's work was completed just before the end of March. In all, 27·8 acres of black wattle were cleared and gave an average yield of 8·7 tons of bark per acre. By reason of the nature of the experiments, some yields were well below this figure, but on the other hand, some plots yielded as much as 17 tons per acre. Four acres of green wattle yielded 7·3 tons per acre. It is of interest to note that in the three years of harvesting crops established and managed throughout by the Institute, overall average yields of black wattle bark have been remarkably constant at 8·9, 8·4, and 8·7 tons. This compares very favourably with the average yield of under 6 tons per acre before the farm was taken over by the Institute.

The farm accounts for the seven months reveal a profit of some R1,280. This figure, however, is completely misleading, since the period covered almost coincides with the revenue-producing portion of the year, whereas the next five months to complete a full year will yield very little income. No valid comparisons, therefore, are possible with previous years.

ADMINISTRATION AND FINANCE

In December, 1961, Mr. M. van N. Möhr left the Committee of Control on his transfer to Sabie and was succeeded by the new Chief Regional Forest Officer, Mr. T. F. F. Garnett. Mr. Möhr joined the Committee in February, 1958, and rendered valuable service both in the Committee itself and, for a time, as its nominee on the S.A.W.G.U. Field Experiment Station Committee.

The Committee of Control met for one special and two ordinary meetings. In October, 1961, Mr. T. F. Mackenzie was appointed Chairman and Prof. A. J. W. Bayer Vice-Chairman, while Prof. E. R. Orchard was nominated as assessor member of the S.A.W.G.U. Field Experiment Station Committee.

Although representations to the Government for an increased grant to the Institute had proved fruitless for the time being, the Committee decided that the ceiling and other limitations imposed upon staff salaries in 1959 could no longer be justified, and these salaries were restored to their true level with effect from 1st September, 1961.

In November, 1961, the Division of Entomology in the Department of Agricultural Technical Services assumed responsibility for all the entomological work previously carried out by Institute staff. For the convenience of the Division, this work is being conducted from its laboratory in Durban.

Expenditure and Income.

Again it is not possible to make comparisons either with the expenditure in previous years or with the estimates for the twelve months to 31st August, 1962, for while some items such as salaries are proportionate to the full year, others are not spread evenly,

notably Library subscriptions and major items of equipment. Outstanding among the last-named is the prototype bark sampling equipment built at a cost of R1,200.

The summarized statement of Expenditure and Income for the period 1st September, 1961, to 31st March, 1962, appears below. Detailed Accounts and Balance Sheet are published separately.

RESEARCH INSTITUTE ACCOUNT

1st September, 1961, to 31st March, 1962

Expenditure	R c	*Income*	R c
Research and Administrative Staff Salaries, etc.	28,656.58	S.A.W.G.U. Grant	23,371.11
Travelling and Subsistence..	1,269.83	Department of Forestry Grant..	11,666.67
Laboratory and Office Equipment and Maintenance ..	1,789.95	Analytical Services	179.54
Library	666.20	Sale of Old Roof Iron.. ..	6.00
Printing and Stationery ..	522.17		
General Administration ..	1,087.15		
Building Maintenance	29.58		
Building Additions	218.53		
Special Provident Fund Reserve	583.33		
Bursary	400.00		
	R35,223.32		R35,223.32

STAFF

An appointment was made to the vacant post of Assistant Silviculturist, but the officer was able to assume duties only after the close of the period under review.

Mr. C. G. Gordon-Gray, who had embarked upon a research investigation for the degree of Ph.D. in pure chemistry, found that he could not satisfactorily continue his studies on a part-time basis and resigned his appointment in September, 1961. Mr. Gordon-Gray joined the Institute staff in March, 1950, and worked on the chemistry of wattle bark, with particular emphasis on analytical problems. He was largely responsible for refinements in the conventional method for tannin determination which substantially improved the reproducibility and concordance of the estimation. He also worked on the seasonal and year to year variations in tannin content of bark. The Institute's good wishes go with him in his future work.

Mr. A. R. Field resigned his post as Technical Assistant to take up professional training in pharmacy and was succeeded in March, 1962, by Mr. P. V. Poggenpoel, After deputizing in the office for Miss E. K. Smith while the latter was on sick leave, Mrs. E. I. Haysom was appointed in October to a part-time post on the staff. She was thus available for full-time duties when Miss Smith was again absent on sick leave in March.

Mr. A. M. MacKenzie, the holder of the Institute's Undergraduate Loan Bursary, completed the course for the degree of B.Sc., gaining a double first in Chemistry and Physics and being placed first in the list in each subject. His tenure of the Bursary has been renewed for a further year during which he is reading the Honours course in Chemistry.

Mr. D. Shepherd, a University undergraduate, was employed for three months during the summer vacation.

ADVISORY WORK, COMMITTEES, CONFERENCES, ETC.

Advisory.

The almost complete cessation of advisory correspondence on entomological questions has drastically reduced the number of advisory letters written. At 41, however, the number referring to other topics is at about the same rate as in the previous year, the largest single group being requests for Institute publications. Enquiries came mainly from Natal, but there were five from countries outside the Republic.

The six advisory visits paid to growers' plantations again reflects the elimination of pest control work and also the fact that the period under review is the season of heaviest pressure of field experimental work.

The thirty or so visitors to the Institute included Mr. J. Wilson, Director of the South African Sugar Association Experiment Station, Professor H. Kappert, formerly Professor of Genetics in the University of Berlin, Dr. J. S. Ladell, of the Ontario Research Foundation, Canada, and Mr. F. J. Gay, of the C.S.I.R.O. Division of Entomology, Australia. The 64 visitors to Bloemendal included a large party of students from Cedara College of Agriculture and a smaller one from the Faculty of Agriculture in the University of Natal, each of which was given a lecture and a field demonstration on wattle silviculture and exploitation.

At the request of the Department of Forestry, the Silviculture Section of the Institute undertook an analysis of a large representative sample of growers' registration forms with a view to deducing from the data contained therein the current production of wattle timber in the Republic and, from the resulting figure, forecasting future production. Although many weeks were spent on this work, the data available unfortunately proved inadequate for this purpose.

The number of commercial bark samples analysed for the Government Bark Inspector increased relatively over the low figure of the previous full year.

Although responsibility for all entomological services had nominally passed to the Division of Entomology, the Institute carried out most of the preliminary arrangements with growers and compiled the schedules for the 1961 bagworm spraying campaign. This was necessary to maintain operations through the transition period before the Government officers concerned had become fully acquainted with the position. The Institute, however, took no part in the spraying operations or in subsequent assessments of results.

Five scientific and technical papers were published during the period under review; details are to be found on page 00 of this Report. In addition, the Institute shared with the Department of Forestry the compilation of the booklet *"The Harvesting and Marketing of Wattle Bark"*.

The resources of the Institute were freely used, mainly by way of consultation with members of the staff and by use of the Library, by both staff and students in the University of Natal, while the Library again took part actively in the inter-library loan scheme. Dr. F. C. J. Zeijlemaker served as external examiner in Plant Physiology to the Department of Botany in the University.

Committees, etc.

Several of the standing committees and councils on which the Director and Mr. Sherry serve have not met during the seven months under review. The Director attended meetings of the General Committee of the Wattle Growers' Union and also of the Union's Pest Control Committee, the Department of Agriculture's Co-ordinating Committee for Entomological Research in the Wattle Industry, and the Leather Industries Research Institute's Wattle Technical Committee. Along with Mr. Sherry, he served on the Field Experiment Station Committee and Royal Show Committee of the Wattle Growers' Union. Mr. Sherry again acted as spokesman for the Wattle Growers' Union in presenting its views on the prevention and control of fires to the South African Agricultural Union. He assisted the Plantation Survey Sub-committee of the Wattle

Growers' Union and served on the Executive Committee and the Plantation Valuation Sub-committee of the South African Timber Growers' Association.

The Director continued in office as Chairman of the South African section of the African Territories Wattle Industry Fund (ATWIF) Wattle Research Advisory Committee and has been executively responsible for the very extensive and detailed liaison with the London section.

Conferences, Lectures, Meetings, etc.

The Director and Mr. Sherry attended and took part in two field days, at Greytown and Ixopo, arranged by the South African Timber Growers' Association.

LIBRARY

Only 8 new books were received in the Library during the seven months period, but a full year's quota, 48 in all, of bound periodicals was added, making the respective totals 428 and 565. The inflow of bulletins, reprints, etc. continued at the high level of the previous year and the 217 received brought the total to 3,828.

ACKNOWLEDGEMENTS

The Institute gratefully acknowledges its indebtedness to the undermentioned.

To the Comec Mimosa Extract Co., Ltd., for again providing facilities for sampling bark from experimental plots.

To the Chief Engineer of the Comec Mimosa Extract Co., Ltd., and the Chief Draughtsman of the Elgin Engineering Co. Ltd. for invaluable assistance in designing field sampling equipment.

To all growers who have made available to the Institute portions of their plantations for experiments.

REVIEW OF WORK IN PROGRESS

(a) SILVICULTURE

1. Thinning, Weeding, and Tending Experiments.

Thinning, fertilizing, or other treatments were carried out in Experiments Nos. S.40 and 48, and S.N.3, 8, 10, 13, and 15 (for details see earlier *Reports*). Experiments Nos. S.1, 3, 5, 10, 11, 12, 34, 44, 45, and 48, and S.N.13 were measured or scored and of these, No. S.1 and portions of Nos. S.3 and S.5, as well as a progeny trial laid down by the Genetics Section, were harvested.

The plantation on the site chosen originally for Experiment S.N.4 at Paulpietersburg, which, because of quota restrictions, could not be stripped last season as planned, has now been felled and this experiment has been laid out. Felling of the plantation on the site chosen for Experiment S.N.5 at Piet Retief is at present in progress and this experiment will be laid out as soon as the site is available.

Experiment S.N.7, originally established on the farm Bloemhof in the Kambula district, has been abandoned at the request of the owner; its counterpart will be laid out on the farm Alford in the same area as soon as stripping of the plantation on the selected site has been completed. The layout has already been surveyed and pegged.

2. Shelterwood Experiments.

Experiment S.14 to test the effectiveness of pines and frost-hardy eucalypts as nurse trees for wattle in frosty areas has been established. The original plan for this experiment has been amended to permit the testing of different planting patterns for the nurse trees and will now take the form of a 7 x 7 latin square.

(b) GENETICS AND PLANT BREEDING

1. Interspecific Hybrids.

Acacia irrorata x A. mearnsii (*black wattle*). The number of leaf glands was scored on six leaves from each of 113 trees in two selfed (F_2) families from presumed hybrids between these species and, also, from 61 trees in a family derived from an attempted backcross to the *irrorata* parent.

In all three families, segregation for the number of glands occurred, but it seems likely that the attempted backcross has resulted largely in selfed seed. The scabrous character of *A. irrorata*, which appears to be almost completely recessive in the F_1, segregated in the three families, but has not yet been scored in detail. The type segregation for glands indicates that the differences between the species in gland number are controlled by a number of genes, but analysis has not yet been completed. There seems to be little doubt, however, that the presumed F_1 crosses between the species are, indeed, naturally occurring hybrids.

2. Intercrossing and Selfing Selected Black Wattle Trees.

(*a*) *Intercrossing.* Intercrossing on clones from selected trees was carried out from September to early November, 1961. In order to include as many trees as possible for testing of combining ability, the programme of crossing was altered somewhat from the previous year. Two trees were selected on each of three sites and these were used as pollen parents to make crosses with as many other selected trees as possible.

In Bloemendal Block 21, trees No. 280 and 283, both of good form and vigour, were crossed on to 30 other trees. Six other cross-pollinations likely to be of interest were also made, making a total of 66 crosses in this group. In Block 26, 13 trees were crossed with No. 137, and 9 of these were crossed with No. 85. Four other crosses were made, giving a total of 26. In the nursery at the Institute, 5 crosses were made in a group of 6 selected trees. In addition to the above, 8 intercrosses were made between 7 inbred (S_1) trees.

(*b*) *Selfing.* On all trees bagged for crossing, a number of inflorescences were also bagged for selfing.

(*c*) *Seed collection.* Seed was collected at frequent intervals during November and December from crosses and self-pollinations made during September and October, 1960. At the same time, records were made of the number of pods set on each inflorescence following crossing or selfing.

3. Progeny Testing of Selected Trees.

(*a*) *Second progeny trial (planted February, 1952, harvested February, 1962).* Before felling the second progeny trial, a sample of four pellets of bark was taken from each tree so as to obtain an estimate of bark thickness. Gumming from the wounds left by the removal of the samples was recorded one month later. At harvesting, bark weights were recorded for each tree and samples for analysis were taken by the Chemistry Section both in the plantation and at the factory.

Although the analysis of the results of this experiment has not yet been completed and it still remains to try to unravel the interacting factors which contribute to the final yield of bark, some results have already emerged.

Significant differences occurred between progenies for bark thickness and although these differences were, in part, correlated with diameter, comparison of the regressions showed that some families have thicker bark than others irrespective of diameter.

Differences in stand between families at time of felling were highly significant, indicating that some progenies have a higher survival rate than others. The yield of bark was high, averaging 13·3 long tons of bark per acre over the whole experiment; the poorest family yielded at the rate of 10·2 tons per acre and the best 17·6 tons per acre. Differences in yield between families were highly significant, but analysis by covariance showed that a considerable part of the significance was due to differences in stand. When corrected for stand, however, significant differences between families still occurred.

4. Vegetative Propagation.

During the season, 437 air-layers were put on 167 trees distributed as follows:

(*a*) Propagation of new selections and a small number of previous failures, 183 layers on 66 trees.

(*b*) Propagation of inbred (S_1) lines, 45 layers on 15 trees.

(*c*) Re-propagation of clonal material, 191 layers on 76 clones.

(*d*) Propagation of trees with short seed ripening period in the second backcross (green wattle x black) x black, 18 layers on 6 trees.

5. Green Wattle Progeny Trial.

Diameter and stand were recorded in the experiment, planted in February, 1952, comparing the second (S_2) inbred generation of green wattle with open-pollinated progeny of the original parent trees. This experiment was harvested during March, 1962.

(c) PLANT PHYSIOLOGY

1. The Biosynthesis of Tannins in Black Wattle.

The tannin content of the leaves, stems, and roots of young black wattle plants was separately determined at monthly intervals from two to six months of age. The

plants were grown from commercial seed in the glasshouse and were selected for uniformity of size. The results are given below, but because the total amounts of tannin are small and the rather crude hide powder method of analysis was used, the figures can be accepted only as indicating very broad trends.

Fresh weight (A) in grams per plant, total tannin content (B) in mg. per plant, and tannin concentration (C) in mg. per gram fresh weight determined on 6-15 *plants.*

Age in months	Roots			Stems			Leaves		
	A	B	C	A	B	C	A	B	C
2	1·0	5	5	3·0	10	3	7·5	50	7
3	2·5	10	4	8·6	30	4	14·8	200	14
4	3·6	10	3	12·6	60	5	16·3	200	12
5	54·9	130	3	46·4	520	11	57·1	1200	21
6	30·4	170	5	66·1	800	12	61·5	1350	22

A marked increase in the total amount of tannin present occurs from about the fourth month. In the case of leaves and stems, this is seen to be the result of two components, the accelerated growth of the plant and the increase in the amount of tannin per unit weight. In the roots, however, growth alone appears to be responsible for the increase, as the concentration of tannin appears to remain constant.

The fact that the tannin content of the leaves is much higher than in the other parts of the plant suggests that this is the main centre of synthesis. It is known, however, that not only tannins and monomeric catechins, but leuco-anthocyanidins also react with hide powder. As leuco-anthocyanidins are known to be produced in leaves of *Eucalyptus* and are presumed to be precursors of condensed tannins, there is good reason to investigate further not only the catechins but the leuco-anthocyanidins also.

2. The Physiology of Gummosis in Black Wattle.

The cause of gummosis has been variously ascribed by earlier workers to bacteria and fungi, but no attempt to induce the condition artificially by inoculation has ever been successful. As a result, gummosis came to be considered as a physiological disease resulting from disturbed water relations and an imbalance in crown-root ratio.

The origin of the condition in each particular case is often to be found in the butt, under a small crack in the bark or around a dead branch, but gum soon appears at points higher up the tree and without visible connection with the origin. This suggests a possible production of toxin at the focus of the disease, by an organism or otherwise, followed by upward translocation to a new site.

To test this hypothesis, pieces of diseased bark and of apparently healthy bark were separately extracted and the two resulting solutions injected into apparently healthy trees. The results were far from conclusive, but there were indications that gummosis might be induced by inoculation with the extract from diseased bark. In several cases, heavy gummosis occurred and, after 2-4 weeks, cracks appeared in the bark 10–100 cm. above and below the site of treatment. These results were obtained on a small number of trees, and fuller investigation on a larger scale is essential before any conclusion can safely be drawn. This, however, must await the next season of active growth.

3. Vegetative Propagation of Black Wattle.

Attempts have been made to root different kinds of cuttings of wattle, notably one- to three-year-old branches cut into mallet type, heeled or straight cuttings, with

or without terminal buds and leaves. The rooting media first tried were river sand, vermiculite, and a sand-peatmoss mixture. All these attempts were unsuccessful and it appeared that the major problem was to keep the cuttings alive along enough for them to produce roots. Further attempts were therefore made by placing the cuttings in water in covered, tall, 600 ml. beakers.

The cuttings were placed into the beakers containing 100 ml. tap water in which different compounds were dissolved. The beakers were covered and placed in the glass-house, where a mist spray apparatus provided moist air by spraying two minutes every hour from 8 a.m. to 4 p.m. The growth hormones indoleacetic acid, naphthylacetic acid and indolebutyric acid, in varying concentrations, alone or in combinations, did not influence the cuttings, nor did addition of sucrose, glucose, salicylic acid, or boric acid.

(d) CHEMISTRY

1. Fertilizer Experiments.

(*a*) *Major factorial experiments.*

(i) *Table Mountain Sandstone.* After rather poor regeneration, a reasonable stand was obtained, only to suffer renewed wind and hail damage this season.

(ii) *Shale.* The young trees made a good recovery from insect attack last year, but were again damaged by wind and hail early in 1962.

(*b*) *Method of application of lime.* This experiment was originally laid down in 1952 following an observation that broadcast lime dressings in a major factorial experiment had significantly reduced froghopper infestation. It was thought that the effect could have been due either to a simple light intensity factor or to some change in sap character. Accordingly a 5 x 5 latin square was laid out at Bloemendal to test these ideas. Unfortunately there was no froghopper infestation during the year or two after treatment. The experiment was allowed to grow to maturity without any annual measurements, and at harvest this season, the following undried bark weights were recorded:

Yield of undried bark in tons per acre

A. Lime 2½ tons/acre dug in	7.82
B. No treatment	8.38
C. Lime 5 tons/acre dug in	7.93
D. Lime 2½ tons/acre broadcast on surface	7.48
E. Lime 5 tons/acre broadcast on surface	8.53
Mean	8.03
Standard error	0.2973
Significant difference (P = 0.05)	0.65

The only valid conclusion from these results is that, at Bloemendal, lime is not beneficial, thus supporting the result from the first cycle of the major factorial experiment there.

2. Bark Analysis.

(*a*) *Routine analysis.* During the period under review, 257 samples of bark were analysed. Of these, 21 were for the Government Inspector of Wattle Bark, while most of the remainder (206) arose from Plant Breeding experiments.

(*b*) *Tree and plot sampling.* In view of the promising results obtained last year using a Veihmeyer soil sampler to obtain bark samples in the field, field sampling equipment was designed to do the job more expeditiously without having to use so much manual labour.

The original idea was to use an air drill, and a special head was made to adapt the Veihmeyer soil sample tubes for this purpose. This was tested on a few bundles of bark at the Comec factory, with moderate success. A complete self-contained engine-compressor-air drill unit was then made and tested in the field. It was found that the

sample tube became clogged before more than two or three bundles had been pierced and that the friction caused the tube to heat unduly. Several different cutting heads were designed and tried, but always with the same result, i.e. pellets jammed in the hot tube and were difficult to extract. Finally the air drill idea was dropped and a compressed-air ram was used to push the bundle on to the sample tube. This proved to be easy to manipulate, there was no heating, and the bark pellets could be collected from the end of the sample tube.

At this stage, the equipment was most cumbersome, but it was later mounted on an old car back axle and fitted with a tractor hitch so that it can now be moved about in a plantation with ease.

It was used to take duplicate field samples for moisture content and larger duplicate samples for tannin analysis from the second progeny trial of the Genetics Section (105 plots) and the fourth series of the Silviculture Section's thinning experiment at Broadmoor (36 plots of 13-year-old trees). These plots were also sampled as usual at the factory so that when the analyses are completed, there will be 242 pairs of results for statistical comparison to judge whether the field samples are sufficiently accurate for future work.

Owing to the failure of the air drill method, the equipment was not available in time for the harvesting of two other silvicultural thinning experiments (72 plots). These were sampled at the factory as in previous years.

3. Variation in Percentage of Tans and Non-Tans with Age.

Four sets of 7-year-old trees were harvested during the period under review. The analytical results will be available later in the year.

4. Trace Element Experiments.

(*a*) *Bloemendal.* The trees made a good recovery from insect attack, but suffered severe wind and hail damage later.

(*b*) *Honey Grove.* After a further filling of blanks early in October, there is now an adequate stand.

5. Soil Moisture.

Electrode readings have been continued at fortnightly intervals. The general picture remains as previously reported, i.e. under older trees rainfall rarely penetrates below two feet, but under very young trees the soil is reasonably moist down to four feet.

RESEARCH PROGRAMME

(a) SILVICULTURE

I. CLIMATIC RELATIONS

Project Silv. 1. Incidence of Frost in Wattle Areas.

OBJECTIVE.

To accumulate information on frost incidence in the wattle-growing areas of the S.E. Transvaal as influenced by aspect and exposure to cold winds, by different radiating surfaces and types of ground cover, and by cultural and slash-disposal methods.

OUTLINE OF EXPERIMENT.

(1) A number of newly-regenerated commercial plantations in frosty locations are selected annually so as to cover a range of aspects and degrees of exposure to cold winds. These are inspected at intervals during their first and second winters, and records of any frost damage, with special reference to temperature and direction of cold winds, are kept.

(2) Direct observations of temperature behaviour in the vicinity of brushpiles, as affected by local topography and the orientation of the brushpiles, are carried out whenever suitable sites in close proximity to Piet Retief can be found.

RESULTS TO DATE.

The results of temperature studies carried out in plots having four different types of radiating surface are described in the *Reports for 1958–1959* and *1959–1960*.

FUTURE PROGRAMME.

Observations will be continued for several years in order to obtain a fair cross-section of winter conditions. Information obtained in this manner will be applied in cultural experiments wherever practicable.

II. HYDROLOGY AND SOIL CONSERVATION

Project Silv. 2. Effect of Plantation Management on Run-off and Erosion.

OBJECTIVE.

To investigate the effect of different methods of slash disposal, including burning, upon run-off and erosion, combined with a general study of the hydrologic cycle in a wattle plantation.

OUTLINE OF EXPERIMENT.

No. S.7 Bloemendal, Pietermaritzburg, Natal (15 *plots*).

The first cycle of this experiment, designed to obtain direct measurements of run-off, litter-loss, and soil-loss from plots in which slash was disposed of as described below, has just been completed. The three slash-disposal treatments were as follows:

(*a*) All slash stacked in continuous piles 12 feet wide and 28 yards apart on the approximate contour.

(*b*) All slash stacked as described in (*a*), but every other pile burnt.

(*c*) All slash stacked in piles 12 feet wide and 12 feet apart and burnt.

These treatments were carried out on moderately-sloping and on steeply-sloping land, and the experimental lay-out was a randomized block arrangement, with plots

split for slope, and two replications. The three treatments were repeated on a very gentle slope outside the experimental area for purposes of comparison.

RESULTS TO DATE.

An interim report, giving experimental results obtained during the first two rainy seasons after the start of the experiment, appeared in the *Report for 1953–1954*. A paper describing the progress of the experiment up to its seventh year was presented at the Third Inter-African Soils Conference at Dalaba in 1959, and the final report on the first nine-year cycle of the experiment appeared in the *Report for 1960–1961*.

IMMEDIATE PROGRAMME.

Treatments (*a*) and (*c*) above were repeated on the same plots after the crop was felled, and a new treatment, in which all slash was removed without the use of fire, was substituted for treatment (*b*). Measurements will be continued throughout the next ten years until the plantation is again felled. Interim results will appear in the *Report for 1962–1963*.

Project Silv. 3. General study of the Hydrologic Cycle in a Wattle Plantation.

OBJECTIVE.

To investigate the changes in ground-water relations through different phases of the wattle cycle.

OUTLINE OF EXPERIMENT.

A series of circulating rain-gauges with which to measure through-fall has been installed near the above experimental area and measurements of stem-flow will also be begun when the trees of the new crop are large enough to make this possible. These measurements will be used in conjunction with the run-off measurements, with measurements of soil moisture in the upper soil layers now being carried out by the Chemistry Section of the Institute, and also with measurements of deep soil-water movements in a borehole carried out by the Geological Survey Division in order to obtain a picture of the general hydrologic cycle.

III. SILVICULTURE

A. SILVICULTURAL SYSTEMS

Project Silv. 4. Regeneration in Frost-prone Areas.

OBJECTIVE.

The regeneration of wattle plantations in frosty areas by means of various felling systems and by the use of other frost-hardy tree species as shelterwood.

OUTLINE OF EXPERIMENTS.

(1) *Experiment No. S.N.*10 *Valsvlei, Panbult, Transvaal* (16 *plots*).

Prior to felling a wattle plantation in an area known to be subject to frost, large trees, well-distributed over the area at a rate of 100 per acre, were selected, and at the time of felling the plantation these trees were stripped standing. Under this dead shelterwood, the new crop was regenerated by sowing, and the following cultivation and weed-control treatments were applied in the form of a latin square.

(*a*) Ground between tree-rows disc-harrowed and left rough.
(*b*) Ground between tree-rows disc-harrowed and smoothed with grader-blade.
(*c*) Ground between tree-rows weeded by hoe and weeds left lying.
(*d*) Ground between tree-rows weeded by hoe and weeds raked and placed on brush-piles.

RESULTS TO DATE.

Regeneration was successfully effected under the dead shelterwood, and scorching of branch-tips and leading shoots by frost was less than in the surrounding unsheltered

stand. Measurement of tree heights was carried out in October, 1961, and the effect, if any, of treatment upon height growth will be described in the *Report for 1962–1963.*

The trees are now tall enough to be reasonably safe from frost damage, and the experiment may be regarded as concluded. It will be repeated, when opportunity permits, on a colder site in the hope that more clear-cut differences between treatments may be obtained.

(2) *Experiment No. S.N.*14 (*To be laid out on a suitable site near Piet Retief in the* 1961–62 *season*). (32 *plots*).

Establishment in the form of a latin square of plots of *Pinus patula* and *Eucalyptus fastigata* on an area where it has proved impracticable to regenerate wattle by conventional methods. Various espacements of the nurse crop trees will be tested, and the possibility of obtaining some financial return from the nurse crop will also be investigated.

B. REGENERATION

Project Silv. 5. Artificial Regeneration.

OBJECTIVE.

To investigate methods of artificial regeneration of wattle on sites where natural regeneration has proved difficult.

OUTLINE OF EXPERIMENT.

*No. S.N.*13 *Waterval, Gluckstadt, Natal* (81 *plots*).

Sowing carried out in November, January, and March to depths of two, three, and four inches, and at rates of one and a half, three, and six pounds of seed per acre.

Laid out as a 3 x 3 x 3 factorial in the form of a quasi latin square.

RESULTS TO DATE.

An assessment of survival was made in November, 1961, and a height measurement will be carried out just before winter. An analysis of the results from this experiment will appear in the *Report for 1962–1963.*

C. ROW ESPACEMENT

Project Silv. 6. Espacement and yield.

OBJECTIVE.

To determine the effect of different row espacements upon yield.

OUTLINE OF EXPERIMENT.

*No. S.*20 *Bloemendal* (27 *plots*).

Plots were established at six-, nine-, and twelve-foot row espacements, and were all thinned at the same rate to a final density of 500 stems per acre. Layout is in the form of a triple latin square.

RESULTS TO DATE.

Measurements of d.b.h at four years of age indicated that a nine-foot row espacement had given significantly better diameter growth than either six-foot or twelve-foot row espacements, and that the diameter growth in a six-foot espacement was significantly better than that in a twelve-foot. (*Report for 1957–1958*).

IMMEDIATE PROGRAMME

Annual re-measurements will be continued until the plots are harvested.

D. STAND DENSITY AND THINNING

Project Silv. 7. Suppression and Release.

OBJECTIVE.

To obtain information on the rate of onset of suppression with increasing density of stand and to test recovery upon release after varying periods of suppression.

OUTLINE OF EXPERIMENTS.

(1) *Experiments Nos. S.*10 *and S.*11 *Bloemendal* (36 + 16 *plots*).

Densities of 100, 200, 300, 400, 500, 600, 700, 800, and 900 stems per acre are represented in the first and densities of 1,000, 2,000, 5,000, and 10,000 in the second.

Each experiment has a randomized block layout with four replications.

RESULTS TO DATE.

Regular annual measurements of diameter have been carried out and a record kept of deaths due to suppression. (*Report for 1956–1957*). Final assessment of results will take place when the trees are ten years old.

IMMEDIATE PROGRAMME.

Annual measurements will be continued until the conclusion of the experiment.

(2) *Experiment No. S.*12 *Bloemendal* (16 *plots*).

Observations on growth rate and fluctuations in population of a number of small plots with stand densities ranging from 10,000 to 40,000 per acre.

RESULTS TO DATE.

Despite the high stand density of these plots, it has been observed that fresh seed has germinated in favourable seasons, and instead of the expected gradual decrease in stand due to deaths resulting from suppression, some plots showed higher densities at three years of age than at one.

IMMEDIATE PROGRAMME.

Observations will be continued annually until the plots reach ten years of age.

(3) *Experiment No. S.*50 *Bloemendal* (25 *plots*).

Plots in a latin square layout were thinned initially to 1,000 stems per acre by one year of age and five treatments applied consisting of release by thinning to 500 stems per acre at two, three, four, five, and six years of age.

RESULTS TO DATE.

None. Differences between treatments, if any, will be assessed after the final thinning at six years of age.

Project Silv. 8. Rate of Thinning.

OBJECTIVE.

To determine the effect of rate of thinning on growth and yield.

OUTLINE OF EXPERIMENTS.

(1) *Experiment No. S.*23 *Bloemendal* (30 *plots*).

Six treatments, consisting of thinning regimes which reduce the stand to a final density of 500 stems per acre in one, two, three, four, and six operations respectively, Layout in randomized blocks with five replications.

RESULTS TO DATE.

No significant differences in growth rate between treatments up to six years of age. Final assessment of results will be made at harvesting.

(2) *Experiment No. S.*33 *Bloemendal* (30 *plots*).

Similar to No. S.23, but with five regimes giving reduction to 500 stems per acre at different rates in two, three, and four operations respectively. Layout in randomized blocks with six replications.

RESULTS TO DATE.

No significant differences in growth up to five years of age. Final assessment to be made at harvesting.

(3) *Experiment No. S.*38 *Bloemendal* (36 *plots*).

Comparison of thinning regimes with early reduction to 1,200, 2,400, and 4,800 seedlings per acre followed by subsequent thinnings in two, three, or four operations to a final stand of 500 stems per acre. Layout is a latin square with six replications.

RESULTS TO DATE.

No significant differences in growth rate up to three years of age. Final assessment to be made at harvesting.

(4) *Experiment No. S.*48 *Bloemendal* (72 *plots*).

Comparison of nine thinning regimes covering reduction to a final stand of 500 stems per acre at mean heights of six, nine, twelve, fifteen, and twenty feet respectively and at two years, three years, four years, and five years of age respectively. Layout in randomized blocks with eight replications.

RESULTS TO DATE.

Statistical comparison of mean plot diameters will be possible only after the final thinning at five years of age.

(5) *Experiment No. S.*43 *Bloemendal* (72 *plots*).

Plots thinned initially to 2,400, 2,000, and 1,600 stems per acre and thereafter in two and four operations respectively to 520 stems per acre. Either no improvement thinning or an improvement thinning to 450 stems per acre carried out at six years or eight years of age. Layout is a 3 x 3 x 2 factorial replicated four times.

RESULTS TO DATE.

Statistical comparison of growth differences will appear in the *Report for 1962–1963.*

Project Silv. 9. Intensity of Thinning.

OBJECTIVE.

To determine the effect of intensity of thinning on growth and yield.

OUTLINE OF EXPERIMENTS.

(1) *Experiment No. S.*1 *Broadmoor, Wartburg, Natal* (36 *plots*).

Comparison on a second quality site of nine thinning intensities managed over four different rotation periods, four intensities being common to all rotation periods. Layout in randomized blocks with four replications for each rotation period.

(2) *Experiment No. S.*3 *Bloemendal* (72 *plots*).

Identical in design and layout with Experiment S.1, but on a third quality site.

(3) *Experiment No. S.*5 *Clan Syndicate Estate, Cramond, Natal* (108 *plots*).

Identical in design and layout with Experiment S.1, but on a first quality site.

RESULTS TO DATE.

Harvesting at seven years and nine years has been carried out in all three of the above experiments, at eleven years in the first two, and at thirteen years in the first only. Estimates of optimum density for maximum bark- and tannin-production computed previously from the yield data so obtained have appeared in *Reports for 1955–1956, 1957–1958,* and *1959–1960,* and results of the 1961–62 measurements will appear in the *Report for 1962–1963.*

IMMEDIATE PROGRAMME.

Harvesting at thirteen and eleven years will be carried out on third and first quality sites respectively during the 1963–64 stripping season.

(4) *Experiment No. S.*34 *Bloemendal* (90 *plots*).

Comparison, on a third quality site, of five thinning intensities managed over rotation periods of eight, ten, and twelve years. Layout in randomized blocks with split plots (rotations in main plots, thinning intensities in sub-plots) and six replications.

RESULTS TO DATE.

None as yet. Estimation on basis of computed yields to be made this year.

(5) *Experiment No. S.35 Otto's Bluff, Pietermaritzburg, Natal* (16 *plots*).

Comparison, on a first quality site, of four thinning intensities in relation to final bark-yield and yield of timber in saleable size-classes. Layout is a latin square with four replications.

RESULTS TO DATE.

At four years of age, plots of 560 stems per acre had grown significantly faster than plots with a density of 660 or more. Final assessment will be made at the time of harvesting.

E. WEEDING AND CULTIVATION

Project Silv. 10. Methods and Effects of Weed-control.

OBJECTIVE.

To investigate effect on growth and yield of various methods of weed-control and of inter-row cultivation and sub-soiling. (*Note*—The economics of these operations and their effect, if any, upon disease incidence in the crop will also be studied.)

OUTLINE OF EXPERIMENT.

(1) *Experiment No. S.24 Bloemendal* (24 *plots*).

Comparison of the effects upon growth and yield of different numbers of disc-harrowing operations to control weed growth and wattle-regrowth between trees established in ten-foot rows, and of hand-hoeing between trees in six-foot rows. Three disc-harrowing operations and one hoeing operation are being tested in a randomized block arrangement with six replications.

RESULTS TO DATE.

Weeding treatments have not had a significant effect upon diameter, but a final assessment of the effect on yield and on disease incidence will be made at harvesting.

(2) *Experiment No. S.31 Bloemendal* (25 *plots*).

Comparison of effects upon growth and weed-control of hoeing, mowing, and three different numbers of disc-harrowing operations in a wattle stand established in nine-foot rows. Layout is a randomized block with five replications.

RESULTS TO DATE.

Weeding treatments have had no significant effect upon either diameter or height up to six years of age. Regular scoring of disease incidence is being continued since there are indications of differences in this respect which may be attributable to treatment. The economic aspects of the different treatments were dealt with in the *Report for 1956–1957.* Final assessment of results will be made at harvesting.

(3) *Experiment No. S.46 Bloemendal* (36 *plots*).

Comparison of effects upon growth and weed-control of mowing and two different numbers of disc-harrowing operations, with and without preliminary subsoiling. Lay-out in the form of a latin square with six replications.

RESULTS TO DATE.

None as yet obtainable. Experiment seriously damaged by insect attack and also by hail over portion of the area at one year of age.

IMMEDIATE PROGRAMME.

Height and d.b.h. measurements will be carried out when the trees are large enough to justify this, and treatment effects, if any, will be assessed on the basis of these measurements.

(4) *Experiment No. S.49 Bloemendal* (40 *plots*).

Similar to S.46, but with three different numbers of disc-harrowing operations. Layout in the form of a randomized block with split plots (weed-control treatments in main plots and subsoiling treatments in sub-plots) and five replications.

RESULTS TO DATE.

None. Height and d.b.h. measurements will be carried out when the trees are large enough, and treatment effects, if any, will be assessed on the basis of these measurements.

(5) *Experiment No. S.N.3 Mooihoek, Piet Retief, Transvaal* (16 *plots*).

Comparison of the effects on growth of weed-control by hoeing and by disc-harrowing, in each case with and without subsoiling. Layout is a latin square with four replications. (*Note*—The effect of treatment upon frost incidence will also be studied.)

RESULTS TO DATE.

Owing to an attack by *Apate* sp., which the management of the estate wished to control by burning over the area, the experiment had to be abandoned. It will be repeated elsewhere in the district when a suitable site can be found.

F. COMPLEX TENDING EXPERIMENTS

Project Silv. 11. Interactions of Various Treatments.

OBJECTIVE.

To investigate the effects of various combinations of such tending treatments as thinning, weeding, subsoiling, pruning, and fertilizer treatments upon growth.

OUTLINE OF EXPERIMENTS.

(1) *Experiment No. S.42 Bloemendal* (81 *plots*).

Comparison of three thinning rates, combined with three different methods of weed-control and three different final stand densities. Laid out as a 3 x 3 x 3 factorial in the form of a quasi latin square.

RESULTS TO DATE.

Presented in the *Report for 1960–1961*.

(2) *Experiment No. S.N.8 Waterval, Glückstadt, Natal* (81 *plots*).

Comparison of three thinning intensities, combined with three different methods of weed-control and dressings of superphosphate fertilizer at three different levels. Laid out as a 3 x 3 x 3 factorial in the form of a quasi latin square.

RESULTS TO DATE.

This experiment has been measured for the first time and the results of this measurement were presented in the *Report for 1960–1961*.

(3) *Experiment No. S.N.4 Municipal Plantations, Paulpietersburg* (81 *plots*).

Identical in design and treatments with Experiment S.N.8. Established by planting during the 1961–62 season.

(4) *Experiment No. S.41 Bloemendal* (81 *plots*).

Comparison of three thinning intensities, combined with three different methods of weed-control and dressings of basic slag and muriate of potash, each at three different levels. Laid out as a 3 x 3 x 3 x 3 factorial in the form of a quasi latin square.

RESULTS TO DATE.

Presented in the *Report for 1960–1961*.

(5) *Experiment No. S.45 Bloemendal* (81 *plots*).

Comparison of three different thinning rates, combined with three different methods of weed-control, three types of live-pruning, and dressings of superphosphate fertilizer at three different levels. Laid out as a 3 x 3 x 3 x 3 factorial in the form of a quasi latin square. (*Note*—The effect of these treatment combinations upon disease incidence will also be studied.)

RESULTS TO DATE.

Presented in the *Report for 1960–1961*.

(6) *Experiment No. S.N.5 Municipal Plantations, Piet Retief* (81 *plots*).

Comparison of three different thinning intensities, combined with three different

methods of weed-control, three rates of subsoiling, and dressings of superphosphate fertilizer at three different levels. Laid out as a 3 x 3 x 3 x 3 factorial in the form of a quasi latin square. This experiment should have been established last season, but quota restrictions precluded the felling of the plantation of the site selected. It will be established during the 1962–63 season.

(7) *Experiment No. S.N.7 Alford, Kambula, Natal* (81 *plots*).

Identical in design and treatments with Experiment S.N.5. This experiment will be established in the 1962–63 season.

VI. PROTECTION

A. AGAINST CLIMATIC AGENCIES

Project Silv. 12. Nutrition in Relation to Frost Injury.

OBJECTIVE.

To investigate the effect of soil dressings of fertilizer or other chemical substances, and of foliar chemical sprays upon the resistance of wattle to frost injury.

OUTLINE OF EXPERIMENTS.

(1) *Experiment No. S.N.15 Groenfontein, Piet Retief, Transvaal* (16 *plots*).

In order to determine whether high nitrogen content of soils plays any part in susceptibility of wattle to frost injury, an area of natural veld on a soil with low organic content and in a very frosty area was selected and, after soil preparation, planted to wattle. Fertilizer treatments, comprising dressings of ammonium sulphate at levels of 100, 200, and 400 pounds per acre, together with an unfertilized control, were arranged in the form of a latin square.

RESULTS TO DATE.

Owing to the small size of the seedlings and the mildness of the winter, no frost injury has yet occurred in any of the plots.

(2) *Experiment No. S.N.16 Valsvlei, Panbult, Transvaal* (36 *plots*).

Following experience in Southern Rhodesia, where foliar sprays of borax, applied to wattle in course of investigations on nutrient deficiencies, appeared to confer some resistance to frost injury, this experiment was planned to test the effect of boron, in the form of both soil dressings and foliar sprays, on frost resistance.

The design of the experiment is a latin square with the following treatments:

(*a*) 2½% borax spray on foliage.

(*b*) 2½% borax spray on foliage plus 15 pounds of borax per acre applied broadcast on the soil and hoed in.

(*c*) 15 pounds of borax per acre applied to the soil and hoed in.

(*d*) As for (*c*) with the addition of a dressing of 200 pounds per acre of superphosphate applied near the tree lines and covered with soil.

(*e*) Superphosphate only applied at the same rate and manner as in (*d*).

(*f*) No treatment.

RESULTS TO DATE.

It is hoped that results will be available at the end of the present winter.

B. AGAINST DISEASE

Project Silv. 13. Causal Agents of Gummosis.

OBJECTIVE.

To investigate the effects of cultural treatments and of deliberate mechanical

damage to the trees upon the incidence of gummosis and woodrot infections in wattle plantations.

OUTLINE OF EXPERIMENTS.

(1) *Experiment No. S.9 Bloemendal (72 plots).*

Investigation of the effect of four different rates of thinning combined with three different methods of weed-control upon the incidence of gummosis. Layout is in the form of randomized blocks with split plots (main plots for weeding and sub-plots for thinning treatments) and six replications.

RESULTS TO DATE.

Treatments have had no significant effect upon gummosis incidence up to six years of age.

IMMEDIATE PROGRAMME.

The experiment will be scored annually for disease up to the time of harvesting.

(2) *Experiment No. S.32 Bloemendal (72 plots).*

Identical with Experiment No. S.9 in design, but with thinning treatments altered.

RESULTS TO DATE.

Treatments have had no significant effect upon gummosis incidence up to three years of age.

IMMEDIATE PROGRAMME.

The experiment will be scored annually for disease up to the time of harvesting.

(3) *Experiment No. S.44 Bloemendal (32 plots).*

Investigation of the effects of weed-control, both with and without injury to the root-system of the tree, upon the incidence of gummosis in wattle. Layout in the form of a latin square with split plots, treatments being as follows:

(*a*) Weeding by hoe with no attempt to avoid root injury.
(*b*) Weeding by hand-pulling with care in the avoidance of root injury.
(*c*) Weeding by regular slashing with care in the avoidance of damage to the trees.
(*d*) Deliberate root injury with no weeding.

Each main weeding plot was split into two sub-plots in which thinning treatments at different rates to the same final density were applied.

RESULTS TO DATE.

No significant differences in disease incidence were evident up to the age of two years.

IMMEDIATE PROGRAMME.

The experiment will be scored annually for disease up to the time of harvesting.

V. WATTLE IN AGRICULTURAL ROTATIONS

Project Silv. 14.

OBJECTIVE.

To utilize the nitrogen fixed in the soil by a wattle crop for improved growth of agricultural crops in a rotational system.

OUTLINE OF EXPERIMENT.

A portion of a wattle plantation, which had occupied worked-out arable land for a ten-year period, was stumped and ploughed after felling, and plots were established in a latin square design to compare the following treatments:

(*a*) Maize grown for grain with dressings of superphosphate and potash.
(*b*) Maize grown for grain with dressing of superphosphate only.
(*c*) Maize grown for silage with dressings of superphosphate and potash.

(*d*) *Eragrostis curvula* grown as a pasture with dressings of superphosphate and potash.

RESULTS TO DATE.

These have been fully reported in *Reports for 1957–1958, 1958–1959,* and *1959–1960.*

IMMEDIATE PROGRAMME.

Treatments will be repeated for one more year, but at this time, half of each plot will receive a dressing of nitrogenous fertilizer, and the plots receiving potash will be given a heavier application than previously. Results will appear in the *Report for 1962–1963.*

VI. CO-OPERATIVE EXPERIMENTS

Experimental plots have been established, normal silvicultural treatment has been applied, and all required measurements are being made for one other project, viz.:

Project Gen. 4. Frost Resistance of Selected Introductions and Progenies.

Note.—In addition to carrying out its own experimental work, the Silviculture Section is responsible for all routine silvicultural operations in all Institute field experiments.

(b) PLANT BREEDING AND GENETICS

I. BLACK WATTLE (*ACACIA MEARNSII*)

A. SELECTION, PROGENY TESTING, AND ACCESSIONS

Project Gen. 1. Selection of Parent Trees.

OBJECTIVE.

To locate, in commercial or experimental plantations, trees superior in morphological characteristics, tannin content, bark thickness, and disease resistance.

OUTLINE OF EXPERIMENT.

First selection made on vigour, stem form, and freedom from gummosis and black butt and then on tannin content and bark thickness estimated from samples taken at one quarter tree-height. On the basis of these samples, a number of the original selections can be discarded; the rest are retained for progeny testing.

IMMEDIATE PROGRAMME.

Continued search for superior trees.

Project Gen. 2. Progeny Trials.

OBJECTIVE.

To determine to what degree characters selected are heritable and to screen parent trees so that those showing superior genetic potential may be propagated vegetatively and go forward to the next stage of the breeding programme.

OUTLINE OF EXPERIMENTS

(1) Open-pollinated progeny of 21 selected trees arranged in a balanced incomplete block design with 5 replicates. Plots, a single line nominally of 17 trees from direct seeding February, 1952. Height, diameter, forking above and below breast height

(b.h.), gummosis, black butt, and yield of bark recorded. Pellets of bark taken at a height of $4\frac{1}{2}$ feet from each tree to give an estimate of bark thickness. Tannin analysis has been carried out on these pellets (grouped in plots) and the results will be compared with two other methods of sampling bark for tannin being carried out by the Chemistry Section.

RESULTS TO DATE.

All characters so far recorded showed significant differences between families.

IMMEDIATE PROGRAMME.

Completion of statistical analysis of results when tannin analyses come to hand. Determination whether pellet samples at the $4\frac{1}{2}$-foot level give a reasonable estimate of the comparative tannin content of the families.

(2) Open-pollinated progeny of 25 selected trees in a 5 x 5 balanced lattice with 6 replications. Plots of 15 trees (nominal) from direct sowing February, 1953. Stand poor and uneven in spite of repeated re-sowing. Records as above plus stand per plot.

RESULTS TO DATE.

Stand and diameter analysed by covariance. Both significant ($P = 0{\cdot}01$). Diameter differences are not affected by stand and *vice versa*.

IMMEDIATE PROGRAMME.

Further recording of diameter and gummosis, and pellet–sampling of bark for determination of bark thickness and tannin content.

(3) Open-pollinated progeny of 25 selected trees in a 5 x 5 balanced lattice with 6 replications. Plots of 10 trees (nominal) transplanted to field in paper pots December, 1954. Records as above plus branching characters.

RESULTS TO DATE.

Differences in diameter, height, amount and type of branching, and forking below b.h. significant ($P = 0{\cdot}01$). Forking above B.H. not significant. Amount and type of branching associated.

IMMEDIATE PROGRAMME.

Further recording and taking of pellet samples of bark.

(4) Open-pollinated progeny of 49 selected trees arranged in a balanced lattice square with 4 replications. Plots nominally of 9 trees transplanted in paper pots December, 1955. Records as in (3), together with quarter-height sampling for bark thickness and tannin content. Gummosis recorded on sample wounds 4 months after sampling.

RESULTS TO DATE.

Significant differences ($P = 0{\cdot}01$) between families for height, diameter, amount of branching, type of branching, forking, general gummosis, and black butt. Significant parent-progeny correlation for gummosis established. Quarter–height bark sampling showed significant differences ($P = 0{\cdot}01$) between families for bark thickness and gummosis on sample wounds. Tannin determinations showed significant differences ($P = 0{\cdot}01$) in tannin content between families. Tannin range $32{\cdot}3\%$ to $41{\cdot}0\%$ between families.

IMMEDIATE PROGRAMME.

Estimation of heritability of characters from parent-progeny correlations and from inter- and intra-class variances.

Project Gen. 3. Comparison of Progenies and New Introductions.

OBJECTIVE.

As in Project Gen. 2 and to test value of new seed accessions.

OUTLINE OF EXPERIMENTS.

(1) Open-pollinated progeny of 32 selected trees, 2 commercial samples, and 15 accessions from Australia arranged in 7 x 7 lattice square with 4 replications. Plots nominally of 7 trees transplanted in paper pots, January, 1958. Stand poor and very uneven. Records of height, diameter, forking above and below b.h., branching characters, gummosis, black butt, yield of bark, and tannin content.

RESULTS TO DATE.

Analysis not yet completed.

IMMEDIATE PROGRAMME.

Routine recording.

(2) Open-pollinated progeny of 28 selected trees, one commercial sample, and 20 accessions in 7 x 7 balanced lattice with 4 replications. Plots nominally of 8 trees transplanted in paper pots January, 1959.

RESULTS TO DATE.

Height differences significant ($P = 0{\cdot}05$).

IMMEDIATE PROGRAMME.

Recording of height, diameter, gummosis, and black butt. Branching to be recorded by reference to a series of "type" photographs which have been prepared.

Project Gen. 4. Frost resistance of Selected Introductions. (In collaboration with Silviculture).

OBJECTIVE.

To test the frost resistance of wattle progenies from seed collected in cold localities in Australia.

OUTLINE OF EXPERIMENTS.

(1) *Experiment No. GSN.1 Mooihoek, Piet Retief, Transvaal.*

Twelve progenies are being tested in a randomized block layout with five replications in a felled wattle area where regeneration has proved difficult on account of frost.

RESULTS TO DATE.

Progenies collected at Cooma, New South Wales, and at Swansea, Tasmania, gave indication of a fairly high degree of frost resistance, combined with a reasonable rate of growth.

IMMEDIATE PROGRAMME.

Scoring for frost damage will be continued and height measurements will be made at regular intervals, probably twice annually.

(2) *Experiment No. GSN.2 Watersmeet, Iswepe, Transvaal.*

Ten progenies are being tested in an area where wattle regeneration was frosted out at the time of felling the previous crop. The layout is in the form of a latin square and the seedlings were planted during the 1961–62 season.

B. INBREEDING

Project Gen. 5. Comparison of Open-pollinated and Self-pollinated Progeny of Selected Trees.

OBJECTIVE.

To study vigour and other characters following the two types of pollination and to assess the amount of natural cross-pollination occurring under plantation conditions.

OUTLINE OF EXPERIMENT.

Self- and open-pollinated progeny of 12 selected trees arranged in split plots with 6 replications. Nominally 12 trees to each sub-plot transplanted from earthenware

pots February, 1951. Records of height, diameter, branching habit, forking, gummosis, black butt, and recessive types such as dwarf, curly, etc.

RESULTS TO DATE.

Inbreeding has produced a marked decrease in vigour and in viability. Inbred lines segregated for a number of seedling recessive characters and also for recessives which appeared in a later stage of growth. Estimated minimum cross-pollination in parents 85 per cent.

IMMEDIATE PROGRAMME.

Felling of experiment in 1962–63 season and final statistical assessment of the results.

Project Gen. 6. Production of S_1 Inbred Lines from Selected Trees.

OBJECTIVES.

(*a*) To assess, where possible, the amount of cross-pollination occurring in parent trees.

(*b*) To give additional information on the inheritance of characters of economic importance.

(*c*) To produce by selection inbred lines superior for economic characters with a view to building up synthetic varieties.

OUTLINE OF EXPERIMENT.

Fifty inbred families have been grown so far and seed of many more is now available. No formal layout used.

RESULTS TO DATE.

Strong resemblances within families and differences between families noted. A small proportion of families have good tree form and reasonable vigour. Significant differences between families for gummosis and black butt established and differences in the type of gummosis attacking a particular family noted.

IMMEDIATE PROGRAMME.

Selection and propagation of individual trees within best families for intercrossing and, if possible, further inbreeding.

Project Gen. 7. Production of S_2 Inbred Lines from Selected S_1 Trees.

OBJECTIVE.

To produce inbred lines more homozygous for certain characters.

OUTLINE OF EXPERIMENT.

Twelve S_2 families sown in 1956, 9 sown in 1958.

RESULTS TO DATE.

Germination poor and many seedlings died in pots. Of those planted out, only small numbers have survived.

IMMEDIATE PROGRAMME.

Attempts to produce S_2 progeny from the more vigorous S_1 families. Scoring of surviving S_2 seedlings.

C. CONTROLLED INTERCROSSING

Project Gen. 8. Intercrossing Clones of Selected Parent Trees.

OBJECTIVE.

To combine, under controlled conditions, trees having high tannin and/or low gummosis in progeny.

OUTLINE OF EXPERIMENTS.

(1) **1958.** Five trees selected for high tannin and 4 for low gummosis used. As many intercrosses as possible attempted within each group.

RESULTS TO DATE.

A total of 14 intercrosses made of which 10 yielded amounts of seed sufficient for planting. Families planted out January, 1961.

IMMEDIATE PROGRAMME.

Recording characters.

(2) **1959.** Thirty-seven intercrosses made between 10 trees in the high tannin group and 21 between 7 trees in the low gummosis group. Records of number of pods set per inflorescence, number of seeds per pod, and seed weights.

RESULTS TO DATE.

Sufficient amounts of seed obtained from 28 intercrosses, smaller amounts from 7 others. Three trees used for intercrossing destroyed by storm before seed ripened.

IMMEDIATE PROGRAMME.

Planting of progeny of intercrosses in a replicated trial together with families from certain inbred intercrosses.

(3) **1960.** Eighteen intercrosses made between 10 trees in high tannin group and 30 between 14 trees in low gummosis group.

IMMEDIATE PROGRAMME.

Counting and harvesting of pod set. Recording seeds per pod and seed weights for open-pollination, self-pollination, and intercrossing.

(4) **1961.** In order to cover as wide a range of trees as possible, a small number of trees has been chosen and these have been crossed on to as many other selected trees as possible.

Trees Nos. 280 and 283, both of good form and vigour, were each crossed on to 30 other trees. Tree No. 137 was crossed on to 13 and No. 85 on to 9 other trees. Fifteen other cross–pollinations were made, giving a total of 98 crosses.

IMMEDIATE PROGRAMME.

Collection and recording of seed pods as they ripen.

Project Gen. 9. Intercrossing Clones of Inbred (S_1) Parent Trees.

OBJECTIVE.

To intercross inbreds with high tannin and/or low gummosis. To test fertility of inbred crosses and possibility of hybrid vigour.

OUTLINE OF EXPERIMENTS.

(1) **1959.** Eight intercrosses made between 8 inbred lines.

RESULTS TO DATE.

Much sterility. Only one cross produced a fairly large number of seed (71), others 0–11 seeds per cross.

IMMEDIATE PROGRAMME.

Sowing such seed as is available.

(2) **1960.** Fifteen intercrosses made among 11 S_1 trees selected for high tannin and 13 among 11 trees selected for low gummosis.

RESULTS TO DATE.

Many intercrosses failed to form pods. Unusually early ripening of pods noted. Harvesting not completed.

IMMEDIATE PROGRAMME.
Collection of seed and estimation of sterility in intercrosses.

(3) **1961.** Eight crosses made between 7 S_1 trees.

RESULTS TO DATE.
Unusually early ripening of pods again noted.

D. VEGETATIVE PROPAGATION

Project Gen. 10. Propagation of Wattle by Means of Air-layers.

OBJECTIVES.
To preserve material in case of accidental destruction of parent tree; to facilitate intercrossing and selfing by bringing flowering branches nearer to ground level; to form "tree shows" to help in analysing inherent characteristics of selected trees; to form a basis for further rapid vegetative increase.

OUTLINE OF EXPERIMENT.
Two to four air-layers placed on each tree, usually on branches in the crown.

RESULTS TO DATE.
Up to 87 per cent success achieved. The similarity of cuttings from the same tree and differences between trees emphasize inherent characteristics which might otherwise be overlooked.

IMMEDIATE PROGRAMME.
Propagation of trees as selected.

Project Gen. 11. Build-up of Stocks.

OBJECTIVE.
To provide clonal material from specially selected trees for the establishment of seed orchards.

RESULTS TO DATE.
Sixty-two rooted air-layers available for planting in coming season.

IMMEDIATE PROGRAMME.
Rapid vegetative increase of a number of trees earmarked as being suitable for inclusion in seed orchards.

Propagation 1962. A total of 437 air-layers put on 167 trees distributed as follows:

(*a*) Propagation of new selections and a small number of previous failures: 183 layers on 66 trees.

(*b*) Propagation of inbred (S_1) lines: 45 layers on 15 trees.

(*c*) Re-propagation of clonal material: 191 layers on 76 clones.

(*d*) Propagation of trees with short seed-ripening period in second backcross (green wattle x black) x black: 18 layers on 6 trees.

RESULTS TO DATE.
Layers placed on trees January, 1962. Forty rooted layers removed April, 1962. Many others forming roots.

Project Gen. 12. Vegetative Propagation of Wattle otherwise than by Air-layering.

OBJECTIVE.
To permit more rapid and less tedious vegetative increase than is possible by air-layering.

OUTLINE OF EXPERIMENT.

Experiments on grafting and striking of cuttings being carried out by East Malling Research Station on behalf of the Wattle Research Institute.

RESULTS TO DATE.

Grafting and striking of cuttings of juvenile trees has been successful. Report on wood from mature trees sent July, 1960, not yet received.

IMMEDIATE PROGRAMME.

When facilities permit, attempts to repeat East Malling's successes under local conditions. See also Plant Physiology, Project Physiol. 3.

E. POLLINATION MECHANISM

Project Gen. 13. Study of Natural Cross-pollination.

OBJECTIVE.

To determine whether wattle is wind- or insect-pollinated, or both.

OUTLINE OF EXPERIMENT.

Seed-set compared on flowering branches

(i) enclosed in bags impervious to insects and wind-borne pollen;
(ii) enclosed in cages excluding large insects, but not wind-borne pollen;
(iii) not enclosed.

RESULTS TO DATE.

Exclusion of insects reduces seed-set, but some anomalous results obtained.

IMMEDIATE PROGRAMME.

Repeat experiment.

II. GREEN WATTLE (*ACACIA DECURRENS*)

A. INBREEDING

Project Gen. 14. Comparison of Open-pollinated and Second Inbred Generation (S_2) Progeny.

OBJECTIVE.

To determine the reduction in vigour brought about by a second generation of inbreeding.

OUTLINE OF EXPERIMENT.

Open-pollinated progeny of 5 selected trees and their S_2 progenies arranged in an incomplete latin square. Plots nominally 15 trees transplanted from earthenware pots, February, 1952. Felled February, 1962.

RESULTS TO DATE.

Second generation of inbreeding shows a further decrease in vigour over the first.

IMMEDIATE PROGRAMME.

Analysis of results.

III. INTERSPECIFIC HYBRIDIZATION

A. GREEN x BLACK WATTLE AND RECIPROCAL

Project Gen. 15. Backcrossing Hybrids to Black Wattle.

OBJECTIVE.

To transfer the dominant shorter seed maturing period of green wattle to black wattle.

OUTLINE OF EXPERIMENT.

Second backcross to black wattle has been grown.

RESULTS TO DATE.

Trees closely resembling black wattle, but with shorter seed ripening period of green wattle, have been obtained. Evidence that as black wattle genetic background increases, modifying genes are affecting the dominance of green wattle seed ripening type.

IMMEDIATE PROGRAMME.

Further backcrossing and vegetative propagation and intercrossing of trees with shorter seed ripening period.

B. OTHER INTERSPECIFIC HYBRIDS

Project Gen. 16. Inheritance in Natural Hybrids.

OBJECTIVE.

To study the inheritance of leaf glands and other characters in a naturally occurring hybrid of *Acacia irrorata* and *A. mearnsii*.

OUTLINE OF EXPERIMENT.

F_2 and backcross seedlings grown and maintained in aluminium pots.

RESULTS TO DATE.

Scoring not completed.

IMMEDIATE PROGRAMME.

Scoring and analysis.

(c) PLANT PHYSIOLOGY

Project Physiol. 1. Biosynthesis of Tannins in Black Wattle.

OBJECTIVE.

To isolate and identify tannin precursors in wattle.

OUTLINE OF EXPERIMENTS.

Wattle plants up to one year old and grown under controlled conditions will be used

(*a*) for progressive analysis of phenolic constituents;
(*b*) for injection and/or feeding experiments in which the effect of possible precursors will be observed.

IMMEDIATE PROGRAMME.

Raising of seedlings in glasshouse in soil, vermiculite, or water culture. Analysis of plant material. Injection and/or feeding of fractions of extracts of wattle and identification of any material producing a significant reaction. Chromatographic and colorimetric analysis will be used.

This work may lead to a further project utilizing labelled carbon (C^{14}) in nutrients and thus following the course of biosynthesis.

RESULTS TO DATE.

Proximate analysis by the hide powder method shows that, in the early months, the tannin content of the leaves is much higher than that in other parts of the plant.

Project Physiol. 2. Physiological Origin and Nature of Gummosis

OBJECTIVE.

To identify the stimulus (? toxin) causing the production of gum and to study the physiological mechanism of gum formation. To investigate the nature of the resistance to gummosis in selected genetic material.

OUTLINE OF EXPERIMENT.

Plant and soil extracts will be injected into healthy plants in an attempt to induce gummosis and identify the causal agent. Fungi and other organisms associated with gummosis will be re-examined. The nature and chemical origin (component sugars) of the gum will be investigated.

IMMEDIATE PROGRAMME.

Isolation and identification of material producing significant reactions. Isolation of suspected pathogenic organisms and inoculation of healthy plants.

RESULTS TO DATE.

Indications have been obtained that gummosis can be transmitted artificially and that diseased bark may contain a toxin capable of producing gummosis.

Project Physiol. 3. Vegetative Propagation of Black Wattle.

OBJECTIVE

To propagate black wattle by means of cuttings.

OUTLINE OF EXPERIMENT.

Different types of cuttings will be subjected to a variety of treatments in attempts to induce rooting.

IMMEDIATE PROGRAMME.

Use of auxins in combination with moisture, heat, and other physical treatments.

(d) CHEMISTRY

A. FERTILIZERS AND SOILS

Project Chem. 1. Major Nutritional Factors.

OBJECTIVE.

To investigate the effect of nitrogen, phosphorus, potassium, and lime, separately and in combination, upon the growth and yield of black wattle and to determine the optimum economic fertilizer application on a variety of soil types.

OUTLINE OF EXPERIMENT.

A 3 x 3 x 3 x 3 factorial experiment on each of the three main soil types in the wattle areas, namely those based on Table Mountain sandstone, shale, and dolerite. Identical treatments repeated in each experiment after harvesting to determine cumulative effects.

RESULTS TO DATE.

The experiments on Table Mountain sandstone and on shale have been harvested and in each, 2 cwt. superphosphate per acre gave a significant and economic response. On shale, 1 cwt. muriate of potash was also beneficial, but there was no evidence of phosphate-potash interaction.

IMMEDIATE PROGRAMME.

Harvesting and analysis of the experiment on doleritic soil. Repeat fertilizer treatment for second cycle.

Project Chem. 2. Comparison of Different Forms of Phosphate.

OBJECTIVE.

To compare the effects of phosphates of different degrees of solubility upon the growth and yield of wattle and to determine the most economic form as fertilizer.

OUTLINE OF EXPERIMENT.

Two 5 x 5 latin squares, one on shale and one on dolerite, using superphosphate, super-raw phosphate mixture, langfos, raw Moroccan rock, and calcium metaphosphate.

RESULTS TO DATE.

The experiment on shale has been harvested and shows that soluble phosphate gives the better response.

IMMEDIATE PROGRAMME.

Harvesting and analysis of the experiment on dolerite.

Project Chem. 3. Placement and Dosage of Superphosphate.

OBJECTIVE.

To determine the optimum rate and method of application of superphosphate.

OUTLINE OF EXPERIMENT.

A 4 x 4 latin square comparing 4 methods of application, viz.

(*a*) half under seed before sowing, remainder between lines one year later,
(*b*) half in bands at first thinning, remainder between lines one year later,
(*c*) all under seed before sowing,
(*d*) all in bands at first thinning,

with six rates of application, viz. 0, 50 lb., 100 lb., 200 lb., 400 lb., and 800 lb. per acre, in split plots.

RESULTS TO DATE.

Applications under the seed have produced the quickest response, but later observations show side-band application to be catching up.

IMMEDIATE PROGRAMME.

Measurements to be continued and final yield and quality to be determined on harvesting in 1963–64.

Project Chem. 4. Trace Elements in Wattle Nutrition.

OBJECTIVE.

To determine the effect of trace elements on growth, yield, and incidence of gummosis in wattle.

OUTLINE OF EXPERIMENTS.

(1) *Commercial Plantations.* Magnesium, copper, iron, molybdenum, boron, manganese, and zinc applied at first thinning in 1960. Plots to be scored annually for gummosis until harvested in 1969–70..

(2) *Selected Genetic Material.* Trace elements as in (1) combined in a factorial experiment with selected susceptible and resistant strains of wattle produced in plant breeding experiments. Application under seed. Annual measurements and scoring as in (1) until harvest in 1971–72.

IMMEDIATE PROGRAMME.

First measurements and scoring of experiment (1), laying down of experiment (2).

Project Chem. 5. Soil Moisture Studies.

OBJECTIVE.

To record the changes in soil moisture with rainfall, season, and phases of the wattle cycle on sites subject to several silvicultural treatments. See Silviculture, Project Silv. 3.

OUTLINE OF EXPERIMENT.

Four stainless steel-nylon electrodes placed at each of four different depths, 1 ft, 2 ft, 3 ft, 4 ft, at the top and bottom of each of 10 run-off plots, 320 electrodes in all. Soil moisture measured by resistance as determined by ohmmeter.

IMMEDIATE PROGRAMME.

Fortnightly readings of soil moisture as indicated by each electrode. Correlation with rainfall records and movement of water table.

B. BARK CONSTITUENTS

Project Chem. 6. Variations in Tan and Non-tan Content of Wattle Bark.

OBJECTIVE.

To study the variations in the content of tans and non-tans through the seasons and through a complete wattle cycle. To determine the optimum age for felling in terms of tannin content.

OUTLINE OF EXPERIMENT.

196 one-eightieth acre plots, each of six trees, laid out in 4 blocks, each of 49 plots. Four plots, in random selection one from each block, harvested every six weeks. Each tree measured for diameter, height, and weight of bark, and each sample of bark analysed.

RESULTS TO DATE.

Trees at 3, 4, 5, and 6 years gave 34·5%, 36·1%, 37·5%, and 38·5% respectively of tannin in the bark.

IMMEDIATE PROGRAMME.

Continuation of measurements and analyses until the experiment ends in 1964–65.

Project Chem. 7. Bark Sampling.

OBJECTIVE.

To devise satisfactory methods for sampling bark both in trees and plots in the field and in bulk commercial consignments.

OUTLINE OF EXPERIMENT.

In course of harvesting operations, various methods of tree sampling such as strips, collars, "pellets", and an aliquot of the total bark are compared with each other and with a conventional "quartered" sample from the whole tree. Sampling by an augur method is being investigated.

RESULTS TO DATE.

Strip, collar, and "pellet" samples have all shown bias; the augur method is promising.

IMMEDIATE PROGRAMME.

Work to be continued through succeeding harvests.

Note.—In addition to carrying out its own experimental work, the Chemistry Section is responsible for the sampling and chemical analysis of the bark from all Institute field experiments.

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Printed by THE NATAL WITNESS (PTY) LTD., *Pietermaritzburg*